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Road Infrastructure and Agricultural Development: A Policy Intervention in a Backward Rural Economy

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Abstract

This paper attempts to examine how progress of rural road infrastructure connecting various desired destinations viz markets, urban centres, healthcare and educational institutions, administrative headquarters, affect economic activity, particularly agricultural performance in rural areas of Meghalaya. The study has a serious policy implication for the development of a backward rural economy. It is purely an empirical study, made with the help of primary data collected from 500 rural households in two prominent districts of the state whose primary occupations are agriculture and related activities. Due to scattered spatial household setting families of the same village face different level of connectivity and thus receive varied facilities whether government sponsored or through private initiative.

Analysing data by Principal Component Analysis to construct an overall Road Development Index at the household level and relating with agricultural earning, price of commodities obtained, wastage, availing various rural development schemes, it is observed that there is significant contribution of road infrastructure on the agricultural growth through enhancing earning capacity, productivity, getting appropriate price, reducing wastage of perishable output and accessing various beneficial schemes. Also, it reflects how availing healthcare facilities and various government schemes is significantly higher in the better connected areas than the areas of poor road development. All these are possible also through better governance and that is due to better road connectivity of the scattered villages.

Keywords: Road Infrastructure, Principal Component Analysis, Road Development Index, Agricultural Development, Meghalaya

Introduction

Infrastructure is a crucial factor in the development of any region. Road network is the only form of transportation that connects Meghalaya with the rest of India in general and other parts of North-Eastern region in

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particular. Efficient road network within the state is also imperative in connecting various remote villages to local Block/District headquarters and other places of importance. However, road connectivity in the state varies significantly in terms of density and quality across the villages and districts.

This paper tried to analyse how road connectivity in the state affect socio-economic development in backward rural areas and particularly benefits agriculture sector through accessibility to various facilities across the villages. The impacts of improvement in road connectivity on various aspects of social and economic development have already been acknowledged in several studies. Levy (1996) and Paudel (2014) through primary survey observed the impacts of improvements of rural roads on the socio-economic conditions of rural masses in terms of lower transportation costs, travel time and better modes of transportation. Hence, it increased agricultural production and facilitated farmers to receive appropriate prices and also raised the farm wages across the villages. Besides, they stressed that better road transportation enhanced rural income through diversification of non-farm employment, reduction of agricultural wastage and improves livelihood through better access to education, healthcare facilities and ultimately make rural people more productive.

Study by World Bank (2001), Kwon (2004) and Africon (2006) showed that investment in rural roads has a significant impact on socio-economic conditions of the rural masses through improved accessibility to social infrastructure like schools and health centres etc, as well as social interaction and mobility. Further, Minten Kyle (1999) mentioned that variation in prices of agricultural products in rural Zaire was due to variation in transportation costs and transaction costs, and both were influenced by quality of road connectivity. Impact of rural roads and modes of transportation on farmers' income, agricultural productivity has also been supported in a number of studies (Tunde and Adeniyi, 2012; Usman et al, 2013; and Yaro, Okon and Bisong, 2014.

Materials and Methods

The study is based on the primary survey in East and West Khasi Hills. Multi stage sampling procedure has been followed for selecting final sample units, the household. As on 2010, both districts have the highest total length of village roads, 439.66 Km and 478.99 Km respectively. In the next stage six Blocks have been identified, from both districts, four Blocks from East Khasi Hills district and two Blocks from West Khasi Hills District*. Again, on the basis of idea on road conditions, ten villages have been selected from the six Blocks purposively on the basis of road connectivity. Four Blocks under East Khasi Hills District are selected (1) Mylliem Block (2) Mawphlang Block (3) Pynursla Block and (4) Shella

Bholaganj Block, where Shillong is the districts headquarter. However, two Blocks under West Khasi Hills District* are selected (1) Mawkyrwat Block and (2) Ranikor Block, where, Mawkyrwat is the districts headquarter.

Five villages were chosen which are well connected to various destinations through roads and the other five which are poor in terms of connectivity. All ten villages have almost similar characteristics of being rural, but vary in terms of road infrastructure, in terms of distance from local Blocks headquarters and District headquarters, activity pattern. From each village fifty families have been chosen by simple random sampling without replacement for investigation and all together there are 500 households for the survey.

To analyse the overall road conditions in these villages and their impact on various aspects of agriculture, information are collected from the sample households on their connectivity to various destinations for meeting multipurpose objectives. Necessary information pertaining to socio-economic conditions, economic activities undertaken by the families, earning from agriculture and other sources, price of agricultural output obtained, wastage of output, cost of cultivation and transportation of inputs as well as outputs etc are collected from the respondents of sample households for the purpose of analysis.*

In order to examine the relation between socio-economic conditions of villagers and the standard of road connectivity, first of all, variation in quality of road across the villages has been described. As type of road varies in different parts or villages, it is difficult to compare in terms of only length of road across the villages. Communication speed depends not only on the length of road, but also on its width and quality in terms of material used and distance of the road from the respective households. Residents of various parts of a village face different connectivity level. Here, for comparison, variation in types of roads in various parts of the villages are taken into consideration and a suitable road development index (RDI) has been constructed.

Construction of Road Development Index (RDI)

On the basis of information gathered from field survey, status of road connectivity to different destinations in all sampled villages has been divided into seven categories. They are (a) road which is non-motorable (b) *Kaccha* road which is muddy (c) a mix of *Kaccha* and semi black topped road (d) partly *Kaccha* and partly black topped road (e) combination of *Kaccha*, semi black topped and black topped road (f) gravel, semi black topped road and (g) well-surfaced black topped road.

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Here the method of factor analysis is applied to investigate whether the selected variables of road connectivity to different destinations are linearly related or not across the families. Also, all these selected variables used for analysis may not be of equal importance and there may be relationship among them. Thus, in order to assign appropriate weight to the above mentioned variables Principal Component Analysis (PCA) technique has been adopted. PCA is a useful technique, where a large number of variables in a data set are transformed into smaller, uncorrelated factors, called the principal components. It also helps in reducing the collinearity among the explanatory variables in question.

Principal component analysis was first mentioned by Pearson (1901) and later on it has been used in many studies for the purpose of factor analysis. Boelhouwer and Stoop (1999) had combined in their study the socio-economic indicators into a single index while measuring well-being of people inNetherlands. Lai (2003) also used the same technique and modified Human Development indicators in China into a single index. Besides, many researchers like Fukuda, Nakamura, and Takano (2007), Rygel, O'Sullivian, and Yarnal (2006) Sekhar, Indrayan, and Gupta (1991) and V. Krishnan, (2010) have used the technique of PCA for the construction of various indices related to their study.

In practice, in order to remove multi collinearity among the explanatory variables, researchers used to combine a number of explanatory variables to form various component vectors, which are orthogonal. This is done as direct application of least square measure yields inconsistent estimates of the individual parameters when there is multi collinearity among the explanatory variables. In this particular case, Kaiser-Meyer-Olkin (KMO) statistical test measuring sampling adequacy and also the Bartlett's test are used. Bartlett's test of Sphericity is used to test the null hypothesis that variables of road connectivity across sampled villages are uncorrelated. The maximum value of KMO is 1.0 and a value of 0.9 is considered as 'Marvellous', 0.80 as 'Meritorious', 0.70 as 'Middling', 0.60 as 'Mediocre' and 0.50 as 'Miserable'. Further, any value of KMO test less than 0.50 are probably not useful for factor analysis and the data is considered to be inappropriate.

After tabular description of data and correlation analysis, an idea is formed about the relation between road connectivity and various agricultural performance indicators like agricultural revenue, its contribution to household earning, wastage of output, price obtained across villages, regression analysis is followed to examine the impact of road connectivity on those agricultural performance indicators. For the purpose, also a composite price index, spoilage index have been constructed in the same way as Road Development Index to have overall indicators of price, spoilage of output of the respective household.

The Extraction Method is carried out for road connectivity by using the SPSS 20 and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.919, which is significant at one percent level of significance. Bartlett's test of Sphericity (6.212E3) is also significant at one percent level of significance indicating that the data is good fit and there is high correlation among the variables.

The correlation matrix (Table 1) indicates that the relationship among the variables is very strong that validates the factor analysis. The correlation matrix shows different destinations like work place, secondary schools, public health centres (PHC), local block office; local market and main market are close and centrally located in the same area. However, location of various health centres on birth delivery and sickness are dispersed and widely scattered, not closely located with the above mentioned destinations.

By putting the above mentioned variables (in the first column of Table 1) to Principal component analysis, eight component scores or factor loadings have been generated (Table 2). Here, each component explains the importance of each variable by providing weight age to each variable using the component score. Table 2 reveals that the highest Eigen value is 6.242 of Component 1 and that provides an explanation of 78.02 percent of the variation in the road connectivity. The corresponding Eigen vectors are obtained with the component matrix (Table 3) by extraction method that provides required weight age with respect to the selected variables. These weights are linearly combined with the respective variables to arrive at the overall score with respect to each household.

Table 1: Correlation Matrix among the Variables Representing Connectivity to Various Desired Destinations

Distance from Residence of Respondents	Work place	Secondary School	PHC*	Health Centre for birth delivery	Hospital for General sickness	Local blocks for schemes	Local Market	Main Market
Work place	1.00	-	-	-	-	-	-	-
Secondary School	.953	1.00	-	-	-	-	-	-
PHC*	.910	.933	1.00	-	-	-	-	-
Health centre for birth delivery	.675	.687	.621	1.00	-	-	-	-
Hospital for General sickness	.370	.383	.394	.343	1.00	-	-	-
Local blocks for schemes	.852	.876	.794	.736	.404	1.00	-	-

Local Market	.932	.929	.951	.622	.390	.806	1.00	-
Main Market	.964	.951	.922	.671	.369	.848	.926	1.00

***Source**: Computed from primary data by the Researcher through Extraction Method, SPSS 20.*

Note: (i) PHC** - Primary Health Centres. (ii) Here connectivity to any of the mentioned places assumes seven values from zero (No road) to Seven (for the best) as a categorical variable mentioned in the text.

Table 2: Total Variance Explained by Different Components Obtained Through PCA

Component	**Initial Eigen values**		
	Total	**% of Variance**	**Cumulative %**
1	6.242	78.026	78.026
2	.818	10.220	88.245
3	.520	6.496	94.741
4	.193	2.419	97.160
5	.099	1.233	98.394
6	.056	.702	99.095
7	.043	.537	99.633
8	.029	.367	100.000
**	6.242	78.026	78.026

***Source**: Results are obtained through Extraction Method, PCA.*
***Note**: ** Extraction Sum of Squared Loading.*

Table 3: Component Matrix

Component Matrix	Component 1
Connectivity to Work place	.967
Connectivity to Secondary School	.974
Connectivity to PHC	.947
Connectivity to health centre for birth delivery	.759
Connectivity to health centre for sickness	.469
Connectivity to local blocks for schemes	.909
Connectivity to Local Market	.952
Connectivity to Main Market	.966

***Source:** Computed from primary data through Extraction Method, PCA and SPSS 20.*

As mentioned above, each variable is multiplied by the corresponding weight age and then added to obtain the required Road Development Index. Correspondingly, each respondent has got a Road development Index value that ranges from 14.39 to 48.6 with interval length of 6.842 for all the respondents. Further, to segregate the quality of road development, the Road Development Index is divided into five grades with equal intervals namely, Poor Road Development, Below Average Road Development, Average Road Development, Above Average Road Development and Very Good Road Development as presented in Table 4.

Table 4: Distribution of Sample Households as per Road Development Index Across Villages (%)

Districts	Blocks	Village	Poor Road Devt.	Below average Road Devt.	Average Road Devt.	Above Average Road Devt.	Very good Road Devt.	Total HHs
East Khasi Hills	Shella Bholaganj	Disong	0	0	4	12	84	50
		Mawryngkhong	24	76	0	0	0	50
	Mylliem	Madan Mawkhar	6	84	10	0	0	50
		Mawsiatkhnam	0	0	0	0	100	50
	Pynursla	Nongkwai	98	2	0	0	0	50
		Nongsdier	0	0	10	10	80	50
	Mawphlang	Nongrum Mawphlang	0	0	0	0	100	50
		Wahlyngkien	36	64	0	0	0	50
West Khasi Hills**	Mawkyrwat	Rangblang	0	0	0	12	88	50
	Ranikor	Nongkynbah	96	4	0	0	0	50
		Overall (%)	26	23	2.4	3.4	45.2	500

Source: *Computed from primary data through Extraction Method, Principal Component Analysis (PCA).*
*Note:HH = Householdand ** indicates South West Khasi Hills formed recently after the survey was conducted.*

Table 5: Grades of Road Development Index (RDI) in the Study Area

Poor Road development	14.39 – 21.232
Below average Road development	21.24 - 28.08
Average Road development	28.09 – 34.932
Above average Road development	34.94 – 41.782
Very Good Road development	41.79 – 49
Source: Computed from primary data by the Researcher through Extraction Method, Principle Component Analysis (PCA) (SPSS) 20.	

Table 4 shows the distribution of sampled households in relation to Road Development Index (RDI) across all the surveyed villages. Overall 45.2 percent of the households fall under very good category of road development index and 26.2 percent of them fall under poor road development index category, which is followed by 22.6 percent of sampled households falling under below average road development index, while only 3.4 percent and 2.4 percent of the respondent households fall under the average and above average road development index respectively. Considering the average and above, about half of the respondents enjoy reasonably good connectivity in the study area.

It is further observed that there is significant variation in quality of road across all the surveyed villages in the two adjacent districts. Some villages in East khasi Hills district have better connectivity, while some are badly connected to different destinations from the point of view of

villagers' requirement in their day to day activities. All the households in Mawsiatkhnam and Nongrum Mawphlangvillages live under the average or very good quality of road condition, which is followed by Rangblang village (88 percent), Disong village (84 percent) and Nongsdier village (80 percent) respectively. At the same time, the worst connected village also fall under East khasi Hills,where 98 percent of households in Nongkwai village face very poor road connectivity and 96 per cent of respondents in Nongkynbah village of† West Khasi Hills fall under poor road connectivity. Besides, 84 percent of households in Madan Mawkhar village in East Khasi Hills fall under below average road development index and that is followed by Mawryngkhong village (76 percent) Wahlyngkien village (64 percent) of the same districts.

Impact of Road Development on Agricultural Earning and Transportation Costs across Sample Villages

Distribution of annual agricultural earning at different level of road development across sample villages is highlighted in tables6 (a) and 6(b).Annual agriculture earning of households in surveyed villages with poor connectivity ranges between Rs1000 or less to Rs300000 and above (Madan Mawkhar, Nongkwai, Nongkynbah and Wahlyngkien) villages. Whereas, in villages with good road connectivity the annual agricultural earning of households ranges betweenRs1000 or less to Rs 150000 and above (Disong, Mawsiatkhnam, Nongsdier, Nongrum Mawphlang and Rangblang) villages. However, average annual agricultural earning in villages with good road network is less as compared to villages with poor road connectivity (Table 6b). It is because most of the sample households in poorly connected villages are predominantly farmers, who depend solely on farming for their survival. However, households in sampled villages with good connectivity are also engaged in other economic activities, where the share of income from farming is comparatively less than that from other sources (Tables 7 and8).

Table 6(a): Annual Agricultural Earning and Road Development across Sampled Villages

Villages under East Khasi Hills	Agricultural Earning (Rs.)	Road Development Index (RDI)					
		Poor RD (%)	Below Avg. RD (%)	Average RD (%)	Above Avg. RD (%)	Good RD (%)	Overall (%)
Disong	0-1000	0 (0)	0 (0)	2 (4)	5 (10)	33 (66)	40 (80)
	1000-5000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)

† Blocks and villages falling previously under erstwhile West Khasi Hills District are now under the newly created district of South West Khasi Hills.

	5000-15000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	15000-25000	0 (0)	0 (0)	0 (0)	1 (2)	3 (6)	4 (8)
	50000-100000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	Overall	0 (0)	0 (0)	2 (4)	6 (12)	42 (84)	50 (100)
Madan Mawkhar	0-1000	2 (4)	10 (20)	5 (10)	0 (0)	0 (0)	17 (34)
	5000-15000	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	1 (2)
	25000-35000	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	1 (2)
	35000-50000	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)	2 (4)
	50000-100000	0 (0)	12 (24)	0 (0)	0 (0)	0 (0)	12 (24)
	100000-150000	0 (0)	16 (32)	0 (0)	0 (0)	0 (0)	16 (32)
	150000-200000	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	1 (2)
	Overall	3 (6)	42 (84)	5 (10)	0 (0)	0 (0)	50 (100)
Mawryngkhong	0-1000	4 (8)	17 (34)	0 (0)	0 (0)	0 (0)	21 (42)
	1000-5000	2 (4)	13 (26)	0 (0)	0 (0)	0 (0)	15 (30)
	5000-15000	6 (12)	8 (16)	0 (0)	0 (0)	0 (0)	14 (28)
	Overall	12 (24)	38 (76)	0 (0)	0 (0)	0 (0)	50 (100)
Mawsiatkhnam	0-1000	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)	7 (14)
	1000-5000	0 (0)	0 (0)	0 (0)	0 (0)	11 (22)	11 (22)
	5000-15000	0 (0)	0 (0)	0 (0)	0 (0)	23 (46)	23 (46)
	15000-25000	0 (0)	0 (0)	0 (0)	0 (0)	5 (10)	5 (10)
	25000-35000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	35000-50000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	Overall	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	50 (100)
	0-1000	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)

Nongkwai	15000-25000	3 (6)	0 (0)	0 (0)	0 (0)	0 (0)	3 (6)
	25000-35000	6 (12)	0 (0)	0 (0)	0 (0)	0 (0)	6 (12)
	35000-50000	25 (50)	0 (0)	0 (0)	0 (0)	0 (0)	25 (50)
	50000-100000	14 (28)	1 (2)	0 (0)	0 (0)	0 (0)	15 (30)
	Overall	49 (98)	1 (2)	0 (0)	0 (0)	0 (0)	50 (100)
Nongrum Mawphlang	0-1000	0 (0)	0 (0)	0 (0)	0 (0)	17 (34)	17 (34)
	1000-5000	0 (0)	0 (0)	0 (0)	0 (0)	11 (22)	11 (22)
	5000-15000	0 (0)	0 (0)	0 (0)	0 (0)	12 (24)	12 (24)
	15000-25000	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	1 (2)
	25000-35000	0 (0)	0 (0)	0 (0)	0 (0)	3 (6)	3 (6)
	35000-50000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	50000-100000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	100000-150000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	Overall	0 (0)	0 (0)	0 (0)	0 (0)	50 (100)	50 (100)
Nongsdier	0-1000	0 (0)	0 (0)	1 (2)	3 (6)	12 (24)	16 (32)
	5000-15000	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	15000-25000	0 (0)	0 (0)	2 (4)	1 (2)	2 (4)	5 (10)
	25000-35000	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)	7 (14)
	35000-50000	0 (0)	0 (0)	1 (2)	0 (0)	9 (18)	10 (20)
	50000-100000	0 (0)	0 (0)	1 (2)	1 (2)	6 (12)	8 (16)
	100000-150000	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)	2 (4)
	Overall	0 (0)	0 (0)	5 (10)	5 (10)	40 (80)	50 (100)
Wahlyngkien	0-1000	5 (10)	20 (40)	0 (0)	0 (0)	0 (0)	25 (50)
	1000-5000	2 (4)	1 (2)	0 (0)	0 (0)	0 (0)	3 (6)

	5000-15000	4 (8)	8 (16)	0 (0)	0 (0)	0 (0)	12 (24)
	15000-25000	2 (4)	3 (6)	0 (0)	0 (0)	0 (0)	5 (10)
	25000-35000	4 (8)	0 (0)	0 (0)	0 (0)	0 (0)	4 (8)
	35000-50000	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
	Overall	18 (36)	32 (64)	0 (0)	0 (0)	0 (0)	50 (100)

Table 6 (a): Concluded

Villages under West Khasi Hills*	Agricultural earning (Rs.)	Road Development Index (RDI)					
		Poor RD (%)	Below Avg. RD (%)	Average RD (%)	Above Avg. RD (%)	Good RD (%)	Overall (%)
Nongkynbah	0-1000	7 (14)	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)
	5000-15000	3 (6)	0 (0)	0 (0)	0 (0)	0 (0)	3 (6)
	15000-25000	7 (14)	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)
	25000-35000	7 (14)	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)
	35000-50000	13 (26)	0 (0)	0 (0)	0 (0)	0 (0)	13 (26)
	50000-100000	9 (18)	0 (0)	0 (0)	0 (0)	0 (0)	9 (18)
	100000-150000	2 (4)	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)
	150000-200000	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
	200000-300000+	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
	Overall	50 (100)	0 (0)	0 (0)	0 (0)	0 (0)	50 (100)
Rangblang	0-1000	0 (0)	0 (0)	0 (0)	1 (2)	23 (46)	24 (48)
	1000-5000	0 (0)	0 (0)	0 (0)	2 (4)	0 (0)	2 (4)
	5000-15000	0 (0)	0 (0)	0 (0)	2 (4)	10 (20)	12 (24)
	15000-25000	0 (0)	0 (0)	0 (0)	0 (0)	3 (6)	3 (6)
	25000-35000	0 (0)	0 (0)	0 (0)	0 (0)	4 (8)	4 (8)
	35000-	0	0	0	1	3	4

	50000	(0)	(0)	(0)	(2)	(6)	(8)
	50000-100000	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	1 (2)
	Overall	0 (0)	0 (0)	0 (0)	6 (12)	44 (88)	50 (100)

Source: *Computed from primary data by the Researcher through Extraction Method SPSS 20*

Note*: RD-Road Development. Figures in Parentheses indicate percentage to total households in the respective village.* ******* *indicates South West Khasi Hills formed recently after the survey was conducted.*

Table 6 (b): Average Annual Agricultural Earning Across Sampled Villages

Village Name	Average Annual Agricultural Earning (Rs)
Disong	5520
Madan Mawkhar	64170
Mawryngkhong	3910
Mawsiatkhnam	10230
Nongkwai	48560
Nongkynbah	45650
Nongrum mawphlang	15790
Nongsdier	32260
Rangblang	11260
Wahlyngkien	8050

Source*: Field Survey by the Researcher.*

The correlation between road development index and average annual earnings generated from agriculture is -.281, which is significant at one per cent level of significance. Similarly, correlations of road development index with percentage of transportation cost to total costs on agriculture, total transportation costs on agricultural products and transportation cost on agricultural input is -.150, -.427and -.952 respectively and all are significant at one per cent level of significance by two tailed test (Table 7).

Table 7: Correlation between RDI with Different Agricultural Variables

Annual Agricultural Earning	Percentage of Transport Cost to total Costing Agriculture	Transportation Costs on Agricultural Products	Transportation Cost on Agricultural Input
-0.281*	-0.150*	-0.427*	-0.952*
Note: * Correlation is at 1 per cent level of significance by two tailed test.			

From the inverse relation between agricultural earnings and road connectivity it appears that better connectivity reduces income from agriculture, which does not match with conventional thinking as cost on transportation as well as wastage are reduced with better connectivity and

farmers may get better price and thus net earnings should increase. It actually supports the earlier result that dependence on agriculture is reduced and employment diversification took place in the well connected villages. Excepting village Mawryngkhong that shows more non-agricultural occupation despite poor road development, other villages are in line with the hypothesis. In this village people mostly work in Lafarge Cement Company after its establishment. In other words, family members engaged in non-agricultural occupation increase with the improvement of road connectivity, which is clear if we look at the proportion of people engaged in occupation other than agriculture across villages with varied road connectivity (Table 8, 9).

Table 8: Percentage of Sampled Households Engaged in Agricultural Activities and Non- Agricultural Activities as Per Road Development Index across Sampled Villages (%)

	Major Occupation of Sample Household Heads (%)		**Road Development Index (%)**					
Village Name	Households Engaged in Agriculture	Households Engaged in Non-agriculture	Poor Road Devt.	Below avg. Road Devt.	Average Road Devt.	Above Avg. Road Devt.	Very good Road Devt.	Total HHs
Disong	4	96	0	0	4	12	84	50
Mawryngkhong*	0	100	24	76	0	0	0	50
Madan Mawkhar	68	32	6	84	10	0	0	50
Mawsiatkhnam	50	50	0	0	0	0	100	50
Nongkwai	96	4	98	2	0	0	0	50
Nongsdier	36	64	0	0	10	10	80	50
Nongrum Mawphlang	4	96	0	0	0	0	100	50
Wahlyngkien	50	50	36	64	0	0	0	50
Rangblang	34	66	0	0	0	12	88	50
Nongkynbah	74	26	96	4	0	0	0	50
Overall (%)	41.6	58.4	26	23	2.4	3.4	45.2	500

***Source**: Computed from primary data by the Researcher.*
***Note**: * indicates that Mawryngkhong villagers are mostly engaged as Daily Wages in Lafarge Cement Company situated in the village and agriculture is not the primary occupation*

Table 9: Percentage of Transportation to Total Agricultural Cost and Road Development Across Sample Villages

Percentage of TransportCostto total cost in Agriculture (%)	**Villages**	**Road Development Index (RDI)**					
		Poor RD (%)	**Below Avg. RD (%)**	**Average RD (%)**	**Above Avg. RD (%)**	**Good RD (%)**	**Overall (%)**
Zero (0)	Disong	0 (0)	0 (0)	4 (8)	5 (10)	32 (64)	41 (82)
	Madan Mawkhar	0 (0)	14 (28)	5 (10)	0 (0)	0 (0)	19 (38)
	Mawryngkhong	13 (26)	37 (74)	0 (0)	0 (0)	0 (0)	50 (100)
	Mawsiatkhnam	0 (0)	0 (0)	0 (0)	0 (0)	5 (10)	5 (10)
	Nongkwai	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
	Nongkynbah	7 (14)	0 (0)	0 (0)	0 (0)	0 (0)	7 (14)
	NongrumMawphlang	0 (0)	0 (0)	0 (0)	0 (0)	16 (32)	16 (32)
	Nongsdier	0 (0)	0 (0)	5 (10)	3 (6)	30 (60)	38 (76)
	Rangblang	0 (0)	0 (0)	0 (0)	0 (0)	24 (48)	24 (48)
	Wahlyngkien	5 (10)	20 (40)	0 (0)	0 (0)	0 (0)	25 (50)
	Overall	26	71	14	8	107	226
Less (1-20)	Mawsiatkhnam	0 (0)	0 (0)	0 (0)	0 (0)	32 (64)	32 (64)
	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	0 (0)	20 (40)	20 (40)
	Rangblang	0 (0)	0 (0)	0 (0)	5 (10)	15 (30)	20 (40)
	Overall	0	0	0	5	67	72
	Disong	0 (0)	0 (0)	0 (0)	0 (0)	9 (18)	9 (18)
	Madan Mawkhar	0	31	0	0	0	31

High (20 above)		(0)	(62)	(0)	(0)	(0)	(62)
	Mawsiatkhnam	0 (0)	0 (0)	0 (0)	0 (0)	13 (26)	13 (26)
	Nongkwai	47 (94)	2 (4)	0 (0)	0 (0)	0 (0)	49 (98)
	Nongkynbah	41 (82)	2 (4)	0 (0)	0 (0)	0 (0)	43 (86)
	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	0 (0)	14 (28)	14 (28)
	Nongsdier	0 (0)	0 (0)	1 (2)	0 (0)	11 (22)	12 (24)
	Rangblang	0 (0)	0 (0)	0 (0)	6 (12)	0 (0)	6 (12)
	Wahlyngkien	10 (20)	15 (30)	0 (0)	0 (0)	0 (0)	25 (50)
	Overall	98	50	1	6	47	202

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in parentheses indicate percentage of total households in respective villages.*

Relation between Road Development and Agriculture Prices in Sample Villages

Distribution of sampled households with respect to agricultural prices obtained for some important agricultural products of the area in relation to the level of road development across sampled villages are highlighted in tables10, 11,12,13,14,15,16, and 17 respectively.

Table 10: Price of Potato in Relation to Road Development across Sampled Villages

Price of Potato	**Name of Villages**	**Road Development Index (%)**				**Overall (%)**
		Poor RD	**Below Avg. RD**	**Above Avg. RD**	**Good RD**	
Rs. 5-10	Madan Mawkhar	0 (0)	2 (4)	0 (0)	0 (0)	2 (4)
	Wahlyngkien	13 (26)	12 (24)	0 (0)	0 (0)	25 (50)
	Overall	13 (26)	14 (28)	0 (0)	0 (0)	27 (54)
Rs. 10-15	Rangblang	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
	Overall	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Rs. 15-20	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	26 (52)	26 (52)
	Overall	0 (0)	0 (0)	0 (0)	13 (26)	13 (26)
Rs. 20-25	Nongrum	0	0	0	2	2

	Mawphlang	(0)	(0)	(0)	(4)	(4)
	Rangblang	0 (0)	0 (0)	3 (6)	17 (34)	20 (40)
	Overall	0 (0)	0 (0)	3 (6)	19 (38)	22 (44)
***Source**: Computed from primary data. **Note**: RD-Road Development, Figures in parentheses indicate percentage of total households.*						

Table 11: Price of Chilli in Relation to Road Development across Sample Villages

Price of Chilli	**Name of Villages**	**Road Development Index (%)**		**Overall (%)**
		Below Avg. RD	**GoodRD**	
Rs.15-20	Madan Mawkhar	4 (8)	0 (0)	4 (8)
	Overall	4 (8)	0 (0)	4 (8)
Rs.20-25	Mawsiatkhnam	0 (0)	4 (8)	4 (8)
	Overall	0 (0)	4 (8)	4 (8)
Rs. 25-30	Mawsiatkhnam	0 (0)	2 (4)	2 (4)
	Overall	0 (0)	2(4)	2(4)
Rs. 35-40	Mawsiatkhnam	0(0)	2 (4)	2 (4)
	Overall	0(0)	2(4)	2 (4)
Rs. 45-50	Mawsiatkhnam	0 (0)	1 (2)	1(2)
	Overall	0 (0)	1 (2)	1 (2)

***Source**: Computed from primary data. **Note**: RD-Road Development. Figures in parentheses indicate percentage of total households.*

Table 12: Price of Bean in Relation to Road Development across Sample Villages

Price of Bean(Rs.)	**Name of Villages**	**Road Development Index (%)**		**Overall (%)**
		Below Avg. RD	**Good RD**	
Rs.10-15	Madan Mawkhar	29 (58)	0 (0)	29 (58)
	Overall	29 (58)	0 (0)	29 (58)
Rs.15-20	Nongrum Mawphlang	0 (0)	4 (8)	4 (8)
	Overall	0 (0)	4 (8)	4 (8)

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in parentheses indicate percentage of total households.*

Table 13: Price of Cabbage in Relation to Road Development across Sample Villages

Price of Cabbage (Rs.)	Name of Villages	Road Development Index (%)			Overall (%)
		Poor RD	Below Avg. RD	Good RD	
Rs. 2-8	Madan Mawkhar	0 (0)	16 (32)	0 (0)	16 (32)
	Overall	0 (0)	16 (32)	0 (0)	16 (32)
Rs. 8-10	Nongrum Mawphlang	0 (0)	0 (0)	4 (8)	4 (8)
	Wahlyngkien	3 (6)	0 (0)	0 (0)	3 (6)
	Overall	3 (6)	0 (0)	4 (8)	7 (14)

Source: *Computed from primary data.*

Note*: RD-Road Development, Figures in parentheses indicate percentage of total households.*

Table 14: Price of Tomato in Relation to Road Development Across Sample Villages

Price of Tomato (Rs.)	Name of Villages	Road Development Index (%)		Overall (%)
		Below Avg. RD	Good RD	
Rs. 10-15	Madan Mawkhar	3 (6)	0 (0)	3 (6)
	Overall	3 (6)	0 (0)	3 (6)
Rs. 15-35	Mawsiatkhnam	0 (0)	10 (20)	10 (20)
	Overall	0 (0)	10 (20)	10 (20)
Rs. 35-40	Mawsiatkhnam	0 (0)	4 (8)	4 (8)
	Overall	0 (0)	4 (8)	4 (8)

Source*: Computed from primary data.*

Note*: RD-Road Development, Figures in parentheses indicate percentage of total households.*

Table 15: Price of Rice in Relation to Road Development across Sample Villages

Price of Rice (Rs)	Name of Villages	Road Development Index (%)				Overall (%)
		Poor RD	Below avg. RD	Above avg. RD	Good RD	
Rs. 12-16	Wahlyngkien	4 (8)	2 (4)	0 (0)	0 (0)	6 (12)
	Overall	4 (8)	2 (4)	0 (0)	0 (0)	6 (12)
Rs. 16-18	Wahlyngkien	4 (8)	2 (4)	0 (0)	0 (0)	6 (12)

	Overall	4 (8)	2 (4)	0 (0)	0 (0)	6 (12)
Rs. 20-25	Rangblang	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
	Overall	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
Rs. 25-30	Rangblang	0 (0)	0 (0)	4 (8)	20 (40)	24 (48)
	Overall	0 (0)	0 (0)	4 (8)	20 (40)	24 (48)
Rs. 30-35	Disong	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)
	Mawsiatkhnam	0 (0)	0 (0)	0 (0)	3 (6)	3 (6)
	Overall	0 (0)	0 (0)	1 (2)	3 (6)	4 (8)
Rs. 35-50	Disong	0 (0)	0 (0)	0 0)	4 (8)	4 (8)
	Overall	0 (0)	0 (0)	0 (0)	4 (8)	4 (8)

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in parentheses indicate percentage of total households.*

Table 16: Price of Ginger in Relation to Road Development Across Sample Villages

Price of Ginger (Rs)		**Road Development Index (%)**			**Overall (%)**
		Poor RD	**Below Avg. RD**	**Good RD**	
Rs. 10-20	Madan Mawkhar	1 (2)	32 (64)	0 (0)	33 (66)
	Overall	1 (2)	32 (64)	0 (0)	33 (66)
Rs. 20-30	Mawsiatkhnam	0 (0)	0 (0)	15 (30)	15 (30)
	Overall	0 (0)	0 (0)	15 (30)	15 (30)
Rs. 30-35	Mawsiatkhnam	0 (0)	0 (0)	2 (4)	2 (4)
	Overall	0 (0)	0 (0)	2 (4)	2 (4)
Rs. 35-40	Mawsiatkhnam	0 (0)	0 (0)	8 (16)	8 (16)
	Overall	0 (0)	0 (0)	8 (16)	8 (16)
Rs. 40-50	Mawsiatkhnam	0 (0)	0 (0)	19 (38)	19 (38)

	Overall	0 (0)	0 (0)	19 (38)	19 (38)
Rs. 50-60	Mawsiatkhnam	0 (0)	0 (0)	1 (2)	1 (2)
	Overall	0 (0)	0 (0)	1 (2)	1 (2)

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in parentheses indicate percentage of total households.*

Table 17: Price of Betel Leaf in Relation to Road Development across Sample Villages

Price of Betel Leaf (Rs.)	Name of Village	Road Development Index (%)			Overall (%)
		Poor RD	Below Avg. RD	Good RD	
Rs. 30-50	Nongkynbah	6 (12)	0 (0)	0 (0)	6 (12)
	Overall	6 (12)	0 (0)	0 (0)	6 (12)
Rs. 50-80	Mawryngkhong	7 (14)	12 (24)	0 (0)	19 (38)
	Overall	7 (14)	12 (24)	0 (0)	19 (38)
Rs. 80-100	Disong	0 (0)	0 (0)	2 (4)	2 (4)
	Nongsdier	0 (0)	0(0)	6(12)	6(12)
	Overall	0(0)	0 (0)	8 (16)	8 (16)
Rs. 100-150	Nongsdier	0 (0)	0 (0)	6 (12)	6 (12)
	Overall	0 (0)	0 (0)	6 (12)	6 (12)

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in parentheses indicate percentage of total households*

The correlations between Road Development Index and prices of agricultural products like potato, chilli, bean, cabbage, tomato, rice, and ginger and betel leaf obtained by the respondents across the villages are respectively 0.913, 0.622, .98, 0.476, 0.767, 0.914, 0.796 and 0.893; which are significant at one per cent level of significance by two tailed test. The indication is that the farmers in good road areas can despatch the output immediately after harvest to the desired destinations and get the appropriate price. Whereas, the farmers of poorly connected areas are deprived of such facility.

Table 18: Results of Correlation between Road Development Index (RDI) and Agricultural Prices

Price of Potato	Price of Chilli	Price of Bean	Price of Cabbage	Price of Tomato	Price of Rice	Price of Ginger	Price of Betel leaf
.913*	.622*	0.98*	.476*	.767*	.914*	.796*	.893*

***Note:** * Correlation is at 1 per cent level of significance by two tailed test.*

Impact of Road Development on Agricultural Spoilage across Sample Villages

Distribution of sampled households with reference to spoilage of agricultural produce in relation to quality of road connectivity across surveyed villages is presented in the tables19, 20, 21 and 22.

Table 19: Road Development and Spoilage of Vegetables across Sampled Villages

Vegetables Spoiled (kg)	Name of Village	Road Development index (%)			Overall (%)
		Poor RD	Below Avg. RD	Good RD	
1-10 (kg)	Madan Mawkhar	0 (0)	1 (2)	0 (0)	1 (2)
	Mawsiatkhnam	0 (0)	0 (0)	13 (26)	13 (26)
	Nongrum Mawphlang	0 (0)	0 (0)	26 (52)	26 (52)
	Overall	0 (0)	1 (2)	39 (78)	40 (80)
30-60 (kg)	Madan Mawkhar	0 (0)	2 (4)	0 (0)	2 (4)
	Nongrum Mawphlang	0 (0)	0 (0)	3 (6)	3 (6)
	Wahlyngkien	3 (6)	0 (0)	0 (0)	3 (6)
	Overall	3 (6)	2 (4)	3 (6)	8 (16)
60-100 (kg)	Madan Mawkhar	0 (0)	3 (6)	0 (0)	3 (6)
	Overall	0 (0)	3 (6)	0 (0)	3 (6)
100-200 (kg)	Madan Mawkhar	0 (0)	5 (10)	0 (0)	5 (10)
	Overall	0 (0)	5 (10)	0 (0)	5 (10)
200-300 (kg)	Madan Mawkhar	0 (0)	2 (4)	0 (0)	2 (4)
	Overall	0 (0)	2 (4)	0 (0)	2 (4)
300-400 (kg)	Madan Mawkhar	0 (0)	9 (18)	0 (0)	9 (18)

	Overall	0 (0)	9 (18)	0 (0)	9 (18)
400-500 (kg)	Madan Mawkhar	0 (0)	8 (16)	0 (0)	8 (16)
	Overall	0 (0)	8 (16)	0 (0)	8 (16)

***Source**: Computed from primary data. **Note**: RD-Road Development. Figures in the parentheses indicate percentage of total households*.

Table 20: Road Development and Spoilage of Potato across Sampled Villages

Potato Spoiled (Kg)	Name of Village	Road Development index (%)				Overall (%)
		Poor RD	Below Avg. RD	Above Avg. RD	Good RD	
10-50 (kg)	Madan Mawkhar	0 (0)	1 (2)	0 (0)	0 (0)	1 (2)
	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	28 (56)	28 (56)
	Rangblang	0 (0)	0 (0)	3 (6)	9 (18)	12 (24)
	Overall	0 (0)	1 (2)	3 (6)	37 (74)	41 (82)
50-100 (Kg)	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	7 (14)	7 (14)
	Rangblang	0 (0)	0 (0)	0 (0)	2 (4)	2 (4)
	Wahlyngkien	2 (4)	2 (4)	0 (0)	0 (0)	4 (8)
	Overall	2 (4)	2 (4)	0 (0)	9 (18)	13 (26)
100-200 (Kg)	Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	1 (2)	1 (2)
	Wahlyngkien	8 (16)	6 (12)	0 (0)	0 (0)	14 (28)
	Overall	8 (16)	6 (12)	0 (0)	1 (2)	15 (30)
200-300 (Kg)	Wahlyngkien	2 (4)	3 (6)	0 (0)	0 (0)	5 (10)
	Overall	2 (4)	3 (6)	0 (0)	0 (0)	5 (10)
300-400 (kg)	Wahlyngkien	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)
	Overall	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)

***Source**: Computed from primary data.*

***Note**: RD-Road Development, Figures in the parentheses indicate percentage of total households.*

Table 21: Road Development and Spoilage of Rice across Sampled Villages

Rice Spoiled (Kg)	Name of Village	Road Development Index (%)				Overall (%)
		Poor RD	Below Avg. RD	Above Avg. RD	Good RD	
30-60 (Kg)	Rangblang	0 (0)	0 (0)	3 (6)	8 (16)	11 (22)
	Wahlyngkien	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)
	Overall	1 (2)	1 (2)	3 (6)	8 (16)	13 (26)
60-100 (Kg)	Wahlyngkien	2 (4)	0 (0)	0 (0)	0 (0)	2 (4)
	Overall	2 (4)	0 (0)	0 (0)	0 (0)	2 (4)
100-200 (Kg)	Wahlyngkien	2 (4)	1 (2)	0 (0)	0 (0)	3 (6)
	Overall	2 (4)	1 (2)	0 (0)	0 (0)	3 (6)
200-300 (Kg)	Wahlyngkien	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)
	Overall	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)

***Source**: Computed from primary data. **Note**: RD-Road Development. Figures in the parentheses indicate percentage of total households.*

Table 22: Road Development and Spoilage of Ginger across Sampled Villages

Ginger Spoiled (Kg)	Name of Village	Road Development Index (%)			Overall (%)
		Poor RD	Below Avg. RD	Good RD	
2-10 (Kg)	Madan Mawkhar	0 (0)	1 (2)	0 (0)	1 (2)
	Mawsiatkhnam	0 (0)	0 (0)	25 (50)	25 (50)
	Overall	0 (0)	1 (2)	25 (50)	26 (52)
10-50 (Kg)	Madan Mawkhar	1 (2)	3 (6)	0 (0)	4 (8)
	Overall	1 (2)	3 (6)	0 (0)	4 (8)
50-100 (Kg)	Madan Mawkhar	0 (0)	2 (4)	0 (0)	2 (4)
	Overall	0 (0)	2 (4)	0 (0)	2 (4)
100-200 (Kg)	Madan Mawkhar	0 (0)	18 (36)	0 (0)	18 (36)
	Overall	0	18	0	18

		(0)	(36)	(0)	(36)
200-300 (Kg)	Madan Mawkhar	0 (0)	7 (14)	0 (0)	7 (14)
	Overall	0 (0)	7 (14)	0 (0)	7 (14)

***Source**: Computed from primary data. **Note**: RD-Road Development, Figures in the parentheses indicate percentage of total households.*

The correlation of road development index and percentage of agricultural produce spoiled in a year like vegetables, potato, rice and ginger produced by sample households are -0.789, -0.795, -0.739 and -0.862, all of which are significant at one per cent level of significance by two tailed test (Table 23).It showed that households in sampled villages with good connectivity can transport their agricultural produce in time to different market centres and as such wastage of agricultural produce are reduced significantly and thus reduce the distress sale considerably.

Table 23: Results of Correlation between Road Development Index (RDI) and Percentage of Agricultural Spoiled Annually

Percentage of Vegetables spoiled	Percentage of Potatoes spoiled	Percentage of Rice spoiled	Percentage of Ginger spoiled
-.789*	**-.795***	**-.739***	**-.862***
Note: * Correlation is at 1 per cent level of significance by two tailed test.			

Road Development and Accessibility to Various Rural Developmental Schemes

Most of the households in the study area have recorded the implementation of various government developmental schemes and programmes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and Integrated Child Development Scheme (ICDS). However, there is significant variation in accessibility to other developmental schemes and programmes like sanitation, housing etc in most of the sampled villages with varied road development as shown in the table 24.

Table 24: Road Development Index and Accessibility to Various Developmental Schemes

Accessibility to Developmental Schemes		Name of Village	Road Development Index (%)					Overall (%)
Total Number and Overall (%)			Poor RD	Below Avg. RD	Average RD	Above Avg. RD	Good RD	
No	300 (60)	Mawryngkhong	13 (26)	37 (74)	0 (0)	0 (0)	0 (0)	50 (100)
		Nongkwai	48 (96)	2 (4)	0 (0)	0 (0)	0 (0)	50 (100)

		Nongkynbah	48 (96)	2 (4)	0 (0)	0 (0)	0 (0)	50 (100)
		Nongsdier	0 (0)	0 (0)	6 (12)	3 (6)	41 (82)	50 (100)
		Rangblang	0 (0)	1 (2)	1 (2)	4 (8)	44 (88)	50 (100)
		Wahlyngkien	15 (30)	35 (70)	0 (0)	0 (0)	0 (0)	50 (100)
		Overall	124	77	7	7	85	300
Yes	200 (40)	Disong	0 (0)	0 (0)	4 (8)	5 (10)	41 (82)	50 (100)
		Madan Mawkhar	4 (8)	41 (82)	5 (10)	0 (0)	0 (0)	50 (100)
		Mawsiatkhnam	0 (0)	0 (0)	0 (0)	1 (2)	49 (98)	50 (100)
		Nongrum Mawphlang	0 (0)	0 (0)	0 (0)	0 (0)	50 (100)	50 (100)
		Overall	4	41	9	6	140	200
Corr. between RDI and Accessibility to Various Developmental Schemes =.470*								
Source: *Computed from primary.* ***Note****: * Correlation is at 1 percent level of significance by two tailed test. RD-Road Development, Figures in parentheses indicate percentage of total households.*								

The correlation between Road development index and accessibility to developmental schemes is found to be positive (0.47), which is significant at one at one per cent level of significance by two tailed test. The indication is that households with good road facility have more access to various developmental schemes with respect to housing, sanitation and other related schemes as compared to the households with poor road category.

Thus, the above findings validate the hypotheses that improvement of road connectivity is significantly related to the accessibility to various amenities and developmental schemes validate the hypotheses that provision of good road connectivity in rural areas has significant impact on the implementation or effectiveness of various developmental schemes and also the accessibility to various amenities in rural villages of the study area.

Impact of Road Development Index (RDI) on Agricultural Performance in the Study Area

In order to explain the impact of road conditions on agricultural performance, a simple regression of road development index on various agricultural variables have been done. Six simple regression models on the effect of road development index on various dependent agricultural variables have been estimated.

The equation is

$$Y_{ij} = C_i + \beta_{ij} X_j + \mu_j$$

$i = 1 \ldots 6$ and $j = 1 \ldots n$
Where , $Y_1 =$ Price index
$Y_2 =$ Spoilage index
$Y_3 =$ Total agricultural earning
$Y_4 =$ Total transportation cost on agricultural produce
$Y_5 =$ Total transportation cost on input
$Y_6 =$ Total earning from allied activities
$X =$ Road Development index

The coefficient β represents the effect of Road Development Index on the respective agricultural, variables across surveyed villages.

Table 25: Correlation Matrix of Agricultural Prices across Sampled Villages

	Price of potato	**Price of Cabbage**	**Price of Chilli**	**Price of Tomato**	**Price of Rice**	**Price of ginger**	**Price of Betel leaf**	**Price of Beans**
Price of potatoes	1.000	-	-	-	-	-	-	-
Price of Cabbage	.059	1.000	-	-	-	-	-	-
price of Chilli	-.059	-.034	1.000	-	-	-	-	-
Price of Tomato	-.069	-.040	.128	1.000	-	-	-	-
Price of Rice	.437	.001	.081	-.054	1.000	-	-	-
Price of ginger	-.140	.136	.404	.482	-.016	1.000	-	-
Price of Betel leaf	-.104	-.060	-.043	-.050	-.082	-.109	1.000	-
Price of Beans	.034	.655	.088	.009	-.079	.247	-.073	1.00
***Source**: Computed from primary data by the Researcher.*								

Here, Price index and spoilage index are constructed in a similar way as that of Road Development Index, with the help of Principal component analysis (PCA) by selecting prices of major agricultural produce of sampled households across surveyed villages. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for Price index is found to be 0.513 (Table 27) and the statistically significant Bartlett's test of Sphericity with probability 0.00 showing a very good fit of the data. Similarly, Kaiser-Meyer-Olkin (KMO) for Spoilage Index is 0.501 (Table 30) and Bartlett's test of Sphericity is 0.00 which is also statistically significant. The correlation matrix of selected prices of agricultural produce is highlighted in Table 25.

Table 26: Results of Kaiser- meyer-Olkin (KMO) and Bartlett's Test for Sampling Adequacy and Collinearity of Agricultural Prices

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.513
Bartlett's Test of Sphericity	Approx. Chi-Square	701.649
	df (Sig.)	28 (.000)
Source: Computed from primary data.		

Table 27: Total Variance Explained of different components obtained through PCA

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.918	23.972	23.972	1.918	23.972	23.972
2	1.584	19.804	43.776	1.584	19.804	43.776
3	1.426	17.826	61.602	1.426	17.826	61.602
4	.947	11.834	73.435			
5	.869	10.860	84.295			
6	.547	6.843	91.138			
7	.390	4.874	96.012			
8	.319	3.988	100.000			
***Source**: Results are obtained through Extraction Method Principal Component Analysis (SPSS) 20*						

There are eight components or factor loadings, explaining the importance of each variable (prices of different agricultural produce) (Table 27). Here, component 1 has the highest Eigen values explaining 23.97 per cent of the variation in agricultural prices across the sampled villages. The corresponding Eigen vector is highlighted in Table 28that provides required weight age with respect to the selected variables. These weights are linearly combined with respective variables to obtain the required Price Index. Thus, each respondent across sampled villages has got a Price index value that ranges from -30.60 to 74.18.

Similarly, for Spoilage index, variables selected are major agricultural products of the area, which are spoiled in a year like vegetables spoiled (Peas, beans, tomatoes, chillies, and cabbages), potatoes spoiled, rice spoiled and ginger spoiled. The correlation matrix among those major agricultural outputs soiled is shown in Table 29. The highest Eigen value of component 1 explains about 47.72 per cent of the variation of agricultural output spoiled across the sampled households of the surveyed villages (Table 31). The corresponding Eigen vector provides required weight age with respect to each selected variable. Again, this weight age are linearly combined with the respective variables to obtain the required

Spoilage Index. Thus, each respondent across sampled villages has a Spoilage index value, which ranges from -245.20 to 729.10.

Table 28: Component Matrix

Variable	Component
Price of Beans	.684
price of Chillies	.463
Price of Tomatoes	.483
Price of Cabbage	.569
Price of Potatoes	-.152
Price of Rice	-.113
Price of ginger	.775
Price of Betel leaf	-.204
Source: Computed from primary data by the Researcher Through Extraction Method, Principal Component Analysis (PCA) SPSS 20.	

Table 29: Correlation Matrix of agricultural output spoiled across sampled villages

	Vegetables spoiled	**Potatoes spoiled**	**Rice Spoiled**	**Ginger Spoiled**
Vegetables spoiled	1.000	-	-	-
Potatoes spoiled	-.039	1.000	-	-
Rice Spoiled	-.021	.686	1.000	-
Ginger Spoiled	.876	-.067	-.042	1.000
***Source**: Computed from primary data by the Researcher through Extraction Method, SPSS 20*				

Table 30: Results of Kaiser- meyer- Olkin (KMO) and Bartlett's test for sampling adequacy and collinearity of agricultural output spoiled

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.501
Bartlett's Test of Sphericity	Approx. Chi-Square	1045.304
	df (Sig.)	6 (.000)
***Source**: Computed from primary data by the Researcher through Extraction Method, SPSS 20*		

Table 31: Total Variance Explained of different components obtained through PCA

Component	**Initial Eigen values**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	1.909	47.728	47.728	1.909	47.728	47.728
2	1.654	41.353	89.081	1.654	41.353	89.081
3	.314	7.839	96.920			
4	.123	3.080	100.000			
***Source**: Results are obtained through Extraction Method PCA, (SPSS) 20*						

Table 32: Component Matrix

Variable	Component
	1
Vegetables spoiled	.908
Potatoes spoiled	-.361
Rice Spoiled	-.336
Ginger Spoiled	.917
Source *Computed from primary data by the Researcher Through Extraction Method, Principal Component Analysis (PCA) SPSS 20*	

Regression Results

Results of Regression of different agricultural variables on Road Development index (RDI) have been presented in Table 33. Almost all the coefficients of Road development index (RDI) are statistically significant. It is observed that road development has significant positive impacts on prices obtained from harvested crops, total earning (revenue) from allied activities which are on expected line. Whereas, spoilage index on agricultural produce, total agricultural earning, total transportation cost on agricultural produce and input are negatively affected by the conditions of road connectivity, indicating significant reduction in cost or wastage with rising quality of road across the villages.

Table 33: Results of Regression of Agricultural Variables on RDI

Dependent Variables	Constant	Coefficient (β)	P value (sig)	Adjusted R Square	F
Price Index	-.270	1.195	0.02 **	.017	9.426
Spoilage index	49.074	-8.561	0.05***	.014	7.940
Total agricultural earning	40195.286	-5520.582	0.00*	.077	42.720
Total Transportation cost on agricultural produce	468.022	-78.746	0.00*	.181	111.10
Total transportation cost on input	448.134	-75.849	0.00*	.024	13.528
Total earning from allied activities	-2624.691	1770.964	0.00*	.080	44.489
Source*: Computed from primary data by the Researcher Through Extraction Method, Principal Component Analysis (PCA) SPSS 20. N = 500* ***Note****: * Correlation is at 1 percent level of significance, **at 5 percent level of significance and *** at 10 percent level of significance by two tailed* test.					

Thus, the results indicate that improvement of road connectivity and its quality enhances agricultural prices in sampled villages, so also the revenue generated from allied activities. Allied activities are carried out mostly by households in sampled villages falling under above average and good road index. Besides, the results indicated that good road decreases spoilage of agricultural produce, so also transportation cost of

agricultural products and total input. Simultaneously, agricultural earning is less with good connectivity as most households falling under above average and good road are predominantly engaged in non-farm activities and other forms of employment to supplement their income. Thus, improvement of roads led to switch over of activities from agriculture to non-farm sector.

Concluding Remarks

The overall analysis reveals that a sizeable portion of households in sampled villages falling under poor road connectivity are predominantly farmers, producing large quantity of different crops as reflected by distribution of households in relation to annual agricultural revenue and road connectivity. Whereas, most of the households in villages falling under good road connectivity are engaged in diversified occupations with small scale of farming and as such annual agricultural revenue is significantly higher in villages with poor road connectivity than those households in villages with good road, except only few households in Mawryngkhong and Wahlyngkien villages.

Besides, villages with good road have lower transportation costs for transporting their agricultural produce to local and main markets as compared to the villages with bad connectivity. Further, households in villages falling under good road development, average transportation costs for transporting agricultural produces ranges between Rs 0 and Rs 600, whereas, households in villages with poor road development have high transportation costs ranging between Rs 0 and Rs 1600.Similarly, transportation costs on agricultural input are less in villages with good road network than in villages with poor connectivity.

Almost all households in sampled villages produce a variety of agricultural produce like potatoes, cabbages, beans, tomatoes, chillies, rice, ginger, betel leaf and others. A massive variation of agricultural prices in these villages can be ascribed to a variation of road connectivity. Where, households with good road development have got better prices of their agricultural produce than those households with bad connectivity that in many cases are compelled to go for distressed sell.

It is also observed that with development of road connectivity, quantity of vegetables spoiled in sampled villages is reduced significantly. Households in villages with poor road development, the amount of vegetables spoiled in a year are more than those households in sampled villages with good road connectivity. Similarly, other agricultural produce like potatoes, rice and ginger the quantity spoiled in a year is less in those households with good road network.

In regard to access to various amenities, most of the households in villages with good road network (Nongrum Mawphlang, Disong) are

found to adequately access various amenities, like cooking fuels, sources of drinking water, toilet arrangement and electricity in comparison to the Nongkwai and Nongkynbah where road connectivity is very poor and they have very poor access to basic amenities, indicating acute deprivation of various amenities and their poor living conditions.

Finally, there is massive variation in accessing various developmental schemes sponsored both by the state and the central governments. Besides, MGNREGA and ICDS schemes, most households with poor connectivity are completely deprived of many developmental schemes like Sanitation programme (SP), Indira Awas Yojana (IAY) and others. However, most households with good road connectivity have access to most of the developmental schemes sponsored by the governments, as good road network enhances mobility to enjoy such developmental programmes.

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